ANTHROPOGENIC CLIMATE CHANGE: THE NEXT EPIDEMIOLOGICAL TRANSTION

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ABSTRACT

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In 1971, Oman posited a theory called the epidemiological transition, which intuitively described that the cause of death in the world started with infectious disease and has shifted drastically to the modern man-made degenerative diseases. As we humans have grown to realize this dilemma, we have taken many measures to mitigate these man-made degenerative diseases, and to a great extent we have been successful thus far. Health, however, is a constant battle, and I believe that a new epidemic is rising. This paper will explore this new epidemic: climate change, and the public's knowledge of its existence, the magnitude of its effects, and their actions to debase its effects. This thesis will answer this question, why is climate change the next human health crisis and how should we combat it?

Climate change is a very real problem in the world, for it has caused extreme flooding drought, and changes in our everyday lives. We humans may have not been the cause of climate change, but we sure enough are speeding up and strengthening its effects. As a last component, this thesis, by analyzing past experiences in controlling epidemics, will hope to propose certain ideas and measures we humans can take to address the current epidemic, climate change.

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Table of Contents

Table of Contents

Preface

Recent developments in global climate have elicited worry among many public health officials worldwide. With the average global temperatures increasing about .8 degrees Celsius over the past century and the expected increase in temperature .3 to 4.8 degrees Celsius, public health officials worry that the repercussions that may come will number many and be very severe. Currently, not many people are working to debase climate change. The thesis question that I will be answering is whether climate change is the next big public health epidemic that we must combat. Firstly, in my thesis, I will describe the current and future climate change effects on human mortality either via infectious causes (i.e. malaria, tick migration, mosquito migration, Zika dispersion) or noninfectious causes (i.e. floods, heat wave, natural disasters). Then I will continue to explore the public's perspective on climate change. I will answer: what do they think is causing climate change? Do they know the mechanism behind the climate change? What do they think they can do to help mitigate the effects? These will all be geared to answer my thesis question, "what extent is the public knowledgeable about the current and future climate care?" As a follow up, to my question at hand, I will propose methods to raise public awareness of this impending issue.

I will look to answer my question by doing heavy literature research. Since this topic is in a global scope and there is many research already done on this issue. I lack the resources nor the time to exact a comprehensive study of public awareness of

global climate change. There is, however, much current literature out there that I can use to answer my question. Much of which I will go to the UT library to find or I will use the UT library databases. There are both primary literature, which I will analyze and interpret, and secondary literature, which provides analysis but I will also analyze further. I will utilize a Social Science method of analysis where I will examine quantitate data of public polls of climate change to interpret if the public knows true reasons behind climate change as I pay special attention to why they think this way. I will also interpret data that discover previous public health issue and how to spread awareness of the issue and pay special concentration towards the successful campaigns and what makes them so special. From there I will construct a model that will help spread awareness to this public health issue at hand.

The title of my thesis will be Anthropogenic Climate Change: the next epidemiological transition. I chose this title because it shows the root subjects that I am talking about: Anthropogenic Climate Change and how it's a major public health issue. In the title, I delineate climate change as a major public health issue by proposing it as the new major epidemic in the world. Epidemiological transition is a public health concept that says that the major cause of mortality was once infectious diseases and now is chronic degenerative diseases. I am proposing that epidemic is receding and the epidemic is mortality caused by climate change and thus, is the new epidemiological transition that the public should be aware of.

Chapter 1: What is the Epidemiological Transition?

Over the years, there have been huge transitions in the major causes of mortality in the World. This major transition, also called the epidemiological transition, was characterized by the transition from the major cause of mortality being infectious diseases and famine to chronic diseases (Santosa et al 2014). This transition is characterized by three phases: the Age of Pestilence (infection) and Famine, the Age of Receding Pandemics, and the Age of Degenerative and Man-Made Diseases. Currently, the country of United States is in the Age of Degenerative and Man-Made Diseases, where the current major cause of death is degenerative and chronic diseases. There are many causes that brought upon the rise of chronic diseases including the longer life expectancy, environmental causes, increased diet, lack of exercise, and the creation of new inventions that seem to be easing our lives. There are many approaches that we must take to combat this rising cause of deaths, and one of these approaches includes taking an environmental approach that has been proven to very effective. In this paper, I will talk about the epidemiological transition, the causes of chronic disease, and an environmental approach that could effectively help overcome this pattern of deaths.

The age of pestilence is the first phase of Omran's theory of epidemiological transition. This age is characterized by high and fluctuating mortality due to epidemic, famine and war, and poor living conditions (Santosa et al 2014). Basically, this was the time when the when there were huge pandemics due to diseases like the black plague, measles, small pox, tuberculosis, and malaria. It is good to note this phase has not ended all around the

world. In many of the third world countries, the transition has started later, and unlike that of industrialized countries, has not yet been completed" (Mackenbach 1994). The phase country or region exists in usually is correlated to how the country is doing economically and socially. If the country is an emerging or developing nation, it may still exist in the age of pestilence and famine, but if the country is a developed nation it is most likely not existing in this age. Proof is shown in figure 1, where you can see that in developed nations like England & Wales and Japan infectious diseases were a part of its past and thus, no longer reside in the age of pestilence and famine, but developing nations like Chile still have high rates of mortality caused by infectious diseases and thus still reside in the age of pestilence and famine (Omran 2005). Furthermore, far into the past, in the 18th century and beyond, the world as a whole was most likely entirely in the age of pestilence because of the fact that there was just not enough technology to combat the infectious diseases and famines. The mid seventeenth century was probably a good time where this phase had taken place, and is a time period of heavy research done on this phase. A study by Graunt in 1939 showed that nearly three-fourths of all deaths were associated with infectious disease, malnutrition and maternity complications (Graunt 1939). In fact, chronic diseases were responsible for less than six per cent of the deaths (Omran 2005). In figure 1, it shows that in England during the 17th century, had about 5 percent of its deaths from the chronic diseases, but a staggering 80 percent of its deaths were caused by infectious disease, lack of nutrition, and maternal and infant deaths. This age is also characterized by high death rates and high birth rates. In fact as shown in figure 2, during the pestilence and famine age there was such high death rate, and sometimes the death rate was higher than the birth rate. Even when the death rate was lower

than the birth rate at this time, it was such a small amount that there was almost an equal number of people dying as there were people being born.

These themes were prevalent and lasted for a long time, but soon new medical technologies caught up causing the age of pestilence and famine to recede, and giving rise to the age of receding pandemics. This age is defined by the time when mortality declines progressively, and the rate of mortality decline accelerates as epidemic peaks become less frequent or disappear (Mackenbach 1994). This stage began roughly 200 years ago, with the inception of the industrial revolution. It is characterized by the improvement in vaccination, improvements in treatments, and improvements in the overall public health care. Sanitation increased in public places, and people have become accustomed to diseases and gained immunity to those diseases that were previously the cause of the epidemics. In fact, the improvement lifestyle has changed so much that life expectancy grew from 30 to 50 years of age (Mackenbach 1994). The industrial revolution brought upon new technologies and innovations that have helped us improve life drastically, but in no way was it a perfect cure of our lives. Technologies brought with it smokestack industries, chemical toxins, working indoors, stress, greater access to less 'healthful' food. Because of this improvement in lifestyle and increase in life expectancy, new diseases arose. Although not very prevalent, the second epidemiological transition brought upon new-chronic, non-infectious, degenerative diseases. Furthermore, rises in allergies, asthma, autoimmune disorders and sexually transmitted diseases were being noticed as well. Overall though, this transition, showed that the nation was quickly developing and that the public health of the nation was looking quite well.

For much of the world that second stage took place in the 1800-1900s, but after the 1900's technology exponentially grew. Improvements in technology lead of course to improvements in healthcare, and from that health industries could make antibiotics that could combat many of the widespread epidemics that occurred in the past. The threat from infectious disease was pretty much null at this point, but what replaced these infectious diseases was equally devastating: chronic diseases. A little background about this age: the life expectancy has increased to over 50, and population growth has become a minimum and stabilized (Barret et al 1998). Population growth, however, was not a minimum unlike like the first age, which occurred due to its high mortality to keep up with the high birthrates. Rather, this second age was defined by better health due to a higher education and newer inventions like condoms. Now birthrates reached a more stable pace, and the death rates were maintained at an all time low, and ushered a new era, the Age of Degenerative and Man made diseases. It seemed that this was an age of prosperity, but what took the place of previously widespread pandemics, were more long term diseases like cardiovascular disease, diabetes, obesity, and cancer. These were diseases that couldn't manifest in the past because the life expectancy was so low, and these diseases had long "latency periods." Thus, these diseases could only manifest because of the higher expectancy of this age, but they were just as debilitating and widespread as the pandemics in the past. Furthermore, increasing water and air pollution subsequent to industrialization have been linked to higher rates of cancer, allergies, birth defects, and impeded mental development (Barret 1998). All in all, this era, although very prosperous, brought upon new diseases that were created by us.

So what are the causes of these man-made degenerative diseases like diabetes and One cause, I have already discussed in my previous paragraph, is the fact we as humans were able to have a life expectancy high enough for expectancy for these diseases to give rise. Unlike immediately felt diseases like malaria, small pox, measles, and meningitis, most of these diseases like hypertension, diabetes, and cancer take a while to develop in the body. Sometimes they don't even arise until the person reaches the age of 60 or higher. What is perplexing is that these later-in-life chronic diseases are now arising also in young children too. For example, in the case of diabetes 2, a chronic disease that can develop at any age due to the inability of tissues in the body to respond to insulin, rates have risen from 3% of all cases of new-onset diabetes in adolescents 10 years ago to 45% of the cases currently (Pinhas et al 2005 & 2007, D'Adamo et al 2011). Diabetes usually takes a numerous years to come forth because it doesn't usually just take one or two days of sweets, sugars, and highly saturated fat food to arise, but rather it usually takes years of eating these fatty foods. Nowadays, however, the diet of children is bad that the time it takes for diabetes to surface in children is as low as 2 years. This leads us to one of the other main causes of these chronic degenerative diseases: our poor diet. The current diet of US consists of about 40% take out meals and only a staggering 60% home cooked meals. Furthermore, when choosing a takeout meal, about 75% of the time Americans chose to eat at fast food places (Quality of U.S diet… 2014). This is extremely daunting because fast food is filled extremely saturated fatty acids, high calories, oils, and high salt content. Instead of eating the USDA recommended 3-5 servings of vegetables and 4 servings of fruit per day, Americans replace these healthy foods with quick-to-obtain fast foods. This poor diet doesn't happen once a month, but rather

it happens everyday for most Americans. This doesn't only cause diabetes in children and adults, but also hypertension, plaque in arteries, and general hypertension. In fact, obesity levels have reached an all time high as more than 68% of Americans are considered obese. Home diet is not the only aspect of diets that are causing Americans to experience these chronic diseases; school diets for children also have a huge effect on the health of children. A research done on public schools showed that most if not all school environments (especially secondary schools) have competitive foods available. These competitive foods consist of "vending machine food," and the presences of these foods are directly related to the students' high intake of total calories, soft drinks, and saturated fat. It is also directly related to a decrease in the intake of fruits and vegetables (Story 2009). Overall, diet in the home and school is a huge cause of many of these degenerative diseases and needs to be improved in order to better public health.

Another major cause of the degenerative diseases is due to the pollution of the environment. Pollution includes the sulfur oxide, nitrogen oxide, particulate matter, ozone, tobacco, and nicotine. A total of 17 cohort studies and 20 case studies in an industrialized country like Sweden showed that an increase in just 10 μg/m3 of pollutant particles in the atmosphere increases chances for cardiovascular diseases 12-14 percent and increased the risk for lung cancer by 15-16 percent. The mechanism behind pollutants causing chronic illnesses is that these ultrafine particles are so small that they like gases are able to pass through the pulmonary epithelium. Once they pass the pulmonary epithelium they have entered in the body's circulation and can directly affect the body by causing plaque build up in lungs and the circulatory system, and activate oncogenes in some of the cells (act as

carcinogens). This directly affects cardiac function and causes chronic illnesses. Pollution doesn't only come from industrial residue, but from people smoking tobacco as well. Smoking also acts in relatively the same mechanism as pollutants, but smoking could have more detrimental effects. Pollutants are much less prevalent in the air, but by smoking tobacco and by experiencing second hand smoking, the pollutants and chemicals from the cigarettes are directly inhaled into the body with higher concentrations. Smoking is so harmful that smoking 1 to 14 cigarettes each day was associated with a six-fold increase in risk of dying from lung cancer and a two-fold increase in fatal coronary heart disease (Chen at al 2009). Furthermore, second hand smoking increases the risk for cardiovascular disease by 25-30% (Healthcare effects of Secondhand smoking 2014). All in all, exposure to outdoor air pollutants accounts like urban air pollutants and smoking can be accounted for a huge portion of chronic illnesses in industrialized countries.

Lastly, another cause of chronic diseases is the lack of an environment that fosters physical activity. For children, physical activity is supposed to be a very important theme that every student should have, and it is at the early age. In the first few years (during elementary school) there has been on average at least 30 minutes of physical activity for the ages that are in elementary school, but as the age gets higher, by the time students are in high school, the average physical activity is about 10 minutes per student (Matthews 2008). This is due to the lack of requirement of physical activity in high schools. Furthermore, the environment around student life does not really foster physical activities among these children. In addition, not only students haven't been keeping up with the required physical activity, but also adults haven't. In fact, only 1 in 5 adults actually meet up with the physical

activity requirement of two and a half hours of exercise per week. In a longitudinal study published in 2012, showed significant decreases in cardiovascular and chronic diseases after physical activity. Without all this urbanization that has gone around, there is really no real environment that helps foster physical activity, and this is a serious cause for chronic illness.

Although the age of degenerative diseases are still persisting, I believe a new age is being ushered in, where the main cause of mortality has shifted from man-made diseases but also death via climate change patterns. I am not, in any aspect, claiming that the age of degenerative diseases is receding. Mortality still persists in that age, but I am proposing that climate change will bring upon much mortality as it continues to amplify in magnitude without any containment.

Chapter 2: What is Climate Change?

Now that we have rediscovered what Omran's three stages of epidemiological transition is, it is time that I propose my new epidemiological transition: the epidemic of anthropogenic climate change. Before we can explore climate change, I should define what climate is. Merriam-Webster defines climate as "the average course or condition of weather at a place usually over a period of years as exhibited by temperature, wind velocity, and precipitation." It is important that we not confuse climate and weather with each other. Whereas weather is the state of the atmosphere at a particular place in a particular time as regards to heat, dryness, sunshine, and precipitation, climate is the usual atmospheric of the place in period of time. In other words, climate is the average, long-term weather patterns in an area, whereas weather occurs during an immediate point in time. Other facets climate can be described with include sunshine, local geography, weather extremes, and basically anything that describes the general weather of an area.

Now that we elucidated the definition of climate, we can start to shape a definition for anthropogenic climate change. In hindsight, if we split up this term up into its words, we get "anthropogenic," "climate," and "change." Anthropogenic means man or human made. We have already clarified the definition of climate, and change means to become different, and when we put the two words together, we get that anthropogenic climate change is the difference in the average weather in a certain region, place, or a global scope caused by humans. This can be a change in the Earth's usual temperature, or it can be a change in where rain and snow usually fall.

It may be evident that the climate seems to be changing just by stepping outside and looking at the news: the higher relative temperatures, the longer droughts, increased number of forest fires and tornadoes, and etc. What, however, is the extent of climate change in the present and what is expected in the future? Furthermore, what evidence is there that the climate change is in any sense anthropogenic? In this chapter, I will look to answer these questions.

First, I will answer the question of what the extent of climate change is in the present. In order to fully assess the climate shift trends in the present, it is useful to look at the Earth over the past 800,000 years. We are able to read and recognize pass weather/temperatures by looking at CaCO3 sediments of ancient animal fossil shells such as that of the animal, foraminifers. The CaCO3 molecules in these shells are very important because they contain oxygen atoms in two different isotopes: oxygen 18 and oxygen 16 (Schmidt 1999). Calculating the ratio between the prevalence of these two isotopes reveals to us the ambient temperature of the particular time period the animal of the fossil was alive. With this, we are able understand climate patterns up to the past 800,000 years. The temperature patterns that are shown in the past show that there has always been a rise and drop of temperatures, and the current climate change is also part of this rise and drop temperature cycles. There is one thing different, however. In the past, it was known that temperature rose 4 to 7 degrees centigrade inn 5000 years, but in about the past century, the temperature has climbed .87 degrees Celsius, which is about ten times faster than previously recorded. Furthermore, in the next century, the rate of temperature increase is expected to increase to twenty times the average rate of increase in the past (Jouzel et al. 2007). It is good to note that this .87 degrees is a mean temperature change of all the temperature of the land and of the oceans. This

means that at some places the temperature change could be 5 degrees and some there could be only a .2-degree change. This just shows that the temperature is rapidly changing in the present, but why is this temperature change important and detrimental to the climate? In the past, it has been proven that only a 5 degree change was enough to put the Earth through an ice age and furthermore, it was enough to bury North America in a huge mass of ice as it did 20,000 years ago. Temperature change affects everything from tornados, hurricanes, animal migration patterns, seal level, droughts, and etc. In the present, one of these reciprocations is that the extreme increase in heat has lead to a decrease in ice sheets. The Antarctic and Greenland ice sheets have decreased in mass significantly. Data from NASA shows that Greenland lost 150 to 250 cubic kilometers of ice per year between 2002 and 2006 alone, and the ice sheets continues to melt faster than they refreeze to this day. Furthermore, the Temperature increase in the Antarctic region is around 2.5 to 4 degrees Celsius, which has led to a shrink this region's ice sheets of about 152 cubic kilometers. Between 2002 and 2005, and the rate of ice sheet melting continues the increase to this day. Furthermore, Arctic sea ice has decreased, on average, 3 percent per decade (Meier et al. 2006) due to the heat, and the rate is slightly increasing. In addition, mountainous glacial ice caps have retreated drastically, and the number of low temperature has been decreasing around the world (especially in the US) such that the amount of spring snow cover in the Northern Hemisphere has decreased over the past five decades, and the snow that does arrive melts way earlier than before (C. Derksen and R. Brown 2012). This melting of various ice forms around the world doesn't just disappear; they contribute to the increase in the global sea levels. The global Sea level has risen about 17 centimeters in the last century (Church and White 2006). Moreover,

the rate of increase of the sea level has doubled in the last decade in comparison to the rate of the last century. This is very detrimental because there are many heavily populated coastal cities and regions below sea level including the majority of the country Netherlands. These places are protected against minimal tidal rising, but if the seas and the oceans continue to rise, these regions will become completely submerged.

More climate repercussions that have risen include an increase in natural disasters like forest fires, tornados, hurricanes, rainfall, and flooding. The warm ocean water engendered by this new drastic temperature elevation is fodder for tropical storms and rainstorms coming from the tropics. This especially affects yearly patterns of rainfall in some regions like monsoons and El Nino. Each year in some places these yearly cycles of rainfall increase due to the hot weather and cause extreme flooding. It may seem like an ok thing because more freshwater rainfall is coming into hot places that need them, but this exorbitant precipitation actually is cause for worry because the flooding does more damage than good, even agriculturally. For example, in a state of India called Assam, where the majority of India's cash crop, Tea, is grown, there is intermittent heavy raining and dry spells throughout the year. This happens cycle of dry and extreme precipitation occurs multiple times throughout the year. This is horrible not only for human life but also for agricultural life: the heavy rainfall washes away the fertile topsoil while the dry spells lead to an increase in pests, which overall causes minimal production of crops. Furthermore, the increase in heat is causing more disaster as rainfall quickly evaporates as well (N.K. 2015). This type of harm to the natural and human world is not only localized in Assam, but is happening worldwide due to the growing climate change. In addition, the increase in global temperatures is inducing

longer and more frequent droughts for many reasons. Firstly, the heightened heat is causing lower amounts of snowfall. For example, in the state of Michigan, the average snowfall per year used to be in the 200 inches range in the 1970's, but since the average snowfall per year has steadily been decreasing, and now sits in the mid 100 inches (Tech. M.). Furthermore, the time the snowfall melts has come sooner and sooner. Research has shown since the advent of the 21st century, the spring melt has started 5 to 15 days sooner than normal. In fact, scientists speculate winter and springtime to actually be around 7 days shorter due to this increase in heat (Westerling et al. 2006). Thus, the fact that there is less snowfall and quicker melting of the snowfall shows that there is less cold precipitation that resides on land. To top that off, the higher temperatures result in more evaporation of water from land, and more transpiration of water from plants. All of this has induced the more frequent and longer droughts in current decade. Moreover, this causes the dry land and dry vegetation, and altogether with the increase in temperature and heightened drought from the high temperatures causes the increase in number and intensity of forest fires in the present than in the past (Westerling 2006).

Lastly, tornado activity has increased heavily in recent years. For example, in the United States, 2011 marked the year for one of the greatest tornado activity recorded in American history, and the tornado activity continues to persist. Despite the climate change decreasing wind shear (a component that is needed more of for more torrential tornados), the warm moist climate from this recent global warming still is fostering the creation of more tornados. I list this aspect of climate change last because research on the effects of climate

change is still not completely conclusive, but there is definitely public and scientific speculation.

Overall, the current climate change is very detrimental as it shows the rise in sea level with the excess heat that could one day submerge cities, Furthermore, it has caused a lower amount of moderate year-round precipitation, but a higher amount of natural disastrous precipitation that cause flooding and mass destruction. In addition, the heat causes huge heat waves, and droughts that ultimately lead to excessive forest fires. All these are some of the environmental impacts the climate change that is happening now, which is very low in magnitude to what will happen in the future.

Next, I will answer the question of future predictions and impacts of climate change. Right now many countries of the United Nations, including US and China, have recently signed an agreement called the Paris Agreement, which states that all nations will try to work together to alleviate the rate of temperature rise. Together they will work to try to keep the temperature rise to below 2 degrees Celsius change in relation to pre-industrial global temperatures and keep it at about 1.5 degrees Celsius. The proposal or the agreement happened in December 12, 2015, but there hasn't been much mitigation of the climate since. In fact, at the rate it is now, the temperature is to reach that quota in the new 15 to 20 years which is very recent. Furthermore, by the end of the 21st century, the temperature change could be up to 4 degree Celsius to what it was at the beginning of the century. This daunting because think of what is happening now, and with this future prediction, the natural disasters and repercussions that result will be drastically and exponentially worse. First to start off, let's look at the ice caps, glaciers, and artic regions. Currently, as I have previously stated,

the amount of melting is higher than the amount of winter precipitation and refreezing of water and ice caps. There is uncertainty to the extent of which the melting will happen, but there is some speculation that we may reach the tipping point of ice melting that will cause the ice to melt, fall, and collapse, which will exponentially increase the melting of the ice. This will lead to a huge increase in sea level and future predictions say that the sea level will increase 20-50 cm to what it is now (Bellard 2012). Furthermore, there will be an increase in torrential precipitation as ocean waters will warm more and more, which gives a higher potential energy for typhoons and tropical storms to be created. This may lead to higher precipitation, but the type of precipitation and what parts will get the precipitation will vary. Some regions will get snow (although most models predict barely any snowfall), some regions will get rain, and some will get barely any precipitation. There will also be huge changes in precipitation patterns. Different regions will experience new climatic phenomena that haven't been seen in that region for generations (Projections of Future Changes in Climate 2007). For example, extra-tropical storm tracks are projected to move pole-wards, with consequent changes in wind, precipitation and temperature patterns, continuing the broad pattern of observed trends over the last half-century. Most likely regions of drought will continue to go through longer and more severe droughts leading to the death of much vegetation and resulting animals of the food web of the environment. The heat waves will also cause much natural destruction via forest fires that will subsequently occur from the heavy heat waves that will occur from the increase in temperature. With that biodiversity will further decrease into deprivation, as ecosystems will be destroyed. In fact, scientists have

predicted that almost a fourth of the current species of the world will go extinct due to the climate change if actions aren't taken into account by the advent of the 22nd century.

Moreover, the future impact will impact ocean environment and it's wildlife as climate change warms the ocean waters, which will increase the potential for the oceans to absorb CO2 in the form of carbonic acid. This will drastically increase the acidity of the water. I didn't explain before, but all these natural disasters that are occurring currently due to climate change have caused a decrease in biodiversity and ecosystems of the world including increased acidity of the ocean waters. Although now the effects of increased acidity of the ocean waters are evidently deleterious in current wildlife, future models say that the acidity will cause for further acidification of up to 35 pH. Most marine animals don't have a wide range of pH where the animal can exist in life, and will ultimately die from the acidity. Also, the animals that die will affect the ecosystem as the animals that do consume these animals that die will also die, and a chain reaction will occur resulting in the extinction or decrease in population of multiple species, which will further decrease the biodiversity of the marine ecosystem (Bellard 2012).

I have previously hinted at this before, but there are possible future abrupt changes or tipping points that will result from climate change in the future. I have already talked about the tipping point of glacier/ ice melting. There is also the fact that as the Arctic permafrost has a huge storage of methane gas, and as the glaciers melt there will be a tipping point where there was a point when the permafrost releases the methane. Methane is a very potent greenhouse gas that will result in increasing the temperature, which will melt the glaciers further, release methane storages even more, and increase temperature further. Furthermore,

the increase in carbon in the air will cause another tipoff, a saturation of C02 in the ocean water. This will cause an overpopulation of plankton and algae, and diminishing population of other species. Furthermore, the CO2 will give rise to increased acidity of the ocean water. At one point the ocean will be fully saturated with carbon dioxide that the rest of the carbon dioxide stays in the atmosphere which would increase global warming further, which will cause more climate change. These sudden tipping points are predicted to happen within the next century if the rate at which temperature is increasing keeps up (Prediction of Global Climate 2011). The daunting fact is that what I have listed above are the probable future predictors of what will happen in the future should humans not do anything to mitigate the repercussions. These are not the worst outcomes but the very probable outcomes. What can we do to debase climate change? Well before we dwell on that it is more important to assess the extent of which climate change is anthropogenic.

Lastly, I will answer to what extent is climate change an anthropogenic cause. I want to first rule out many what many who oppose anthropogenic climate change claim: that the temperature change of the Earth is due to the natural trends of Earths climate rising in temperature and decreasing in temperatures. In the past, there has been a common theme of increase and decrease of global Earth temperature that has been directly linked with the three common causes: Variations in the Sun's energy reaching earth via the earth's position, changes in the reflectivity of the Earth's surface or libido, and changes in the greenhouse gas effect, which effects the change in the amount of heat that is retained by the Earth's atmosphere (Judith 2010). None of these motifs alone causes heating up of the earth or the presence of climate, but rather all aspects together have to be present in order to induce a

climate in general. Climate can be altered or aggravated beyond the normal trend, however, if one of these motifs were to be altered slightly.

The first motif or the effects of Milankovitch cycles on climate are naturally altered to affect the climate, and there are three Milankovitch cycles that naturally cause climate change: The extent of how elliptical the Earth's orbit is, the degree of tilt the Earth has towards the Sun, and the extent of which the Earth wobbles on its axis. On top of the Milankovitch Cycles, there is also the amount of solar energy that is emitted by the Sun, for there are times when the sun emits higher intensity solar waves (Yugi 2015). Each of these Milankovitch cycles and the sun's solar waves causes the Sun's solar energy absorbed by the earth to increase or decrease extensively. If the Sun's energy from solar waves, however, increased, there wouldn't be an immediate change in the climate or the temperature of Earth's atmosphere, but over time it will cause the aggravation of an increased temperature in Earth's atmosphere. Presently, there has been evidence that the irradiance caused by the sun via sunlight on Earth's surface has been decreasing in the past few decades. Furthermore, in terms of the Milankovitch cycles, the temperature of the Earth is predicted to be in decline. Moreover, according to the trends of the past 800,000 years, the global temperature is supposed to be decreasing (Mann et al 1999). This is actually pretty daunting because even though most of the natural factors that cause temperature change point in the direction of decreasing global temperature, the opposite is actually true.

If many of the natural causes don't work towards to the present climate change, then it must be due to anthropogenic causes. The first cause is in relevance to the second motif, the reflectivity of the Earth's surface or albedo. The reflectivity of solar energy is caused by

many factors: permafrost, cloud coverage and atmosphere, and vegetation. Through the production of the third motif, greenhouse gasses, man has caused the climate to increase, which subsequently caused the decrease in permafrost or snow coverage on Earth. The decrease in ice coverage on Earth has resulted in a decrease in reflectivity of the Earth's atmosphere and surface. Furthermore, heavy deforestation and a decrease of vegetation in the world has caused the reflectivity to decrease further (Grenfall et al. 1994). In fact since the past, the forest has decreased from covering over to 50% of the global land surface to currently covering around 31% of the global land surface (Runyan 2016). This has contributed to an increase in temperature because Earth lacks the reflectivity that it once had and takes in more sunlight than it ever had before.

I have hinted this before greenhouse gasses, or the third motif has an effect on the climate change too. This part also has a huge anthropogenic factor as well. As I have explained in chapter 1 much of climate change is engendered by the production of greenhouse gasses, which create a shield from solar radiation from escaping the Earth. Anthropogenically, there are few industrial made molecules that make up greenhouse gasses: Nitrous Oxide, C02, methane, and CFCs. Of those 4 greenhouse gasses, CFC's have very prevalent industrial production and are entirely industrial made. CO2 is put into the atmosphere through many causes such as respiration and volcanic eruption. As a more consequential factor of releasing carbon dioxide, humans have burned fossil fuels and caused heavy deforestation. The atmospheric CO2 concentrations have increased by a third due to human activity since the Industrial Revolution. Although CO2 is in the highest concentration of greenhouse gasses, CO2 only has a Global Warming Potential (GWP) of 1 (Young et al

2009). The other two gases methane and nitrous oxide are created from burning fossil fuels, and the prevalence of these particles in the atmosphere are almost entirely anthropogenic. Nitrous oxide has a GWP of 298, and methane has a GWP of 25, and these particles keep growing in intensity due to human efforts (2.10.2 Direct Global Warming Potentials 2010). Before the industrial age, the prevalence of greenhouse gases ranged from 172 to 300 parts per million, and since the industrial age, the concentration of greenhouse gases on the Earth is 401.5 ppm. Furthermore, emissions of the greenhouse gases have increased by 2.3 % on average every year (Lockwood 2009). IPCC (Intergovernmental Panel on Climate Change) has claimed that more than 95% of the current climate change can be attributed to anthropogenic factors.

In conclusion, climate change is a very evident factor of the modern world, and will have increasing detrimental effects in the future. I have elucidated that much of the climate change is a byproduct of manmade greenhouse gases and advancement of human technology. It is without a doubt that the anthropogenic effects on climate must be elucidated or public health outcomes can be detrimental. I will list out these outcomes in the next chapter.

Chapter 3: Public Health Anticipation of Climate Change

We have looked at many of the effects of climate change in a more environmental perspective, but I have not revealed the public health anticipation of the effects of climate change (that is how will it affect human health). As we have said in the previous chapter, climate change causes rising temperatures, more extreme weather, and rising sea levels. It is amplified by the relentless anthropogenic increase in greenhouse gas levels. Some of the human health detriments to climate change include air pollution, increase in allergens, more severe weather causing human mortality, extreme-heat related illnesses, environmental degradation, water and food supply impacts, water quality impacts, and changes in vector ecology. I will dissect each of these health impacts to better explain how climate change is connected to them as well as the expected impact on human health

As I have stated in the previous chapter, the amount of natural disaster will increase due to increasing global temperatures, and with that will come a harm to human health either by causing death, by injuring some, or by destroying health infrastructures that are built in the society. According to AccuWeather, the average yearly number of natural disasters was 78 in 1970 and by 2004; this number had increased to 348. Furthermore, corresponding with the World Bank's "Natural Disaster Hotspots: A Global Risk Analysis" reports show that over 160 countries hold more than one-fourth of their populations in regions of high mortality risks from one or more natural disasters (Garret 2015). With the growing global temperatures, the number of natural disasters should increase, and thus, increasing the danger for more people. Some of the natural disasters that climate change has induced are: floods,

hurricanes, droughts, tornados, etc. (as I have explained in the last chapter). These natural disasters are a direct detriment to human health, but they can also induce multiple other factors that also are a pernicious to humans.

Firstly, much of the natural disasters such as floods, hurricanes, droughts, and tornadoes can cause environmental degradation. Environmental degradation can make the quality of life very poor and allow for appearances of more primitive elements like mold and fungus. Furthermore environmental degradation can cause impacts on food supplies, especially on agriculture. In developed nations, food is not being rationed as much and food supply impacts may not be as potent yet. In developing nations, however, food supply is a big issue, and if the environment that provides food has been harmed by natural disasters, the food could also be damaged, if not destroyed. This can impose a serious health problem to the people in developing nations as without food people will not have the energy to build up immune system and do basic functions. Food is essential in keeping the health of every human being. Climate change has caused for more frequent droughts and less average yearly global rainfall, resulting in less agricultural supply. In fact a recent Stanford Study showed, that the food production of wheat and maize would have been 5% higher since 1980, if not for climate change's effect on the food production (Clark 2012). Furthermore, recent IPCC (intergovernmental panel on climate change) report estimated that parts of the subtropics and the low latitudes could experience declining agricultural conditions. In fact, across Africa, yields from rain-fed agriculture could decline by as much as 50% by 2020 (Easterling et al. 2007). Water is also an absolute necessity for every human being. Lack of water can also result from climate change, and without water, the body's major functions like physical

activity, regulating blood pressure, regulating body temperature, and transporting nutrients can not be fully functional and may cause the person to be severely injured or die. Furthermore, the body becomes severely susceptible to strokes, heart failures, and dehydration. In fact, in United States there have already been estimates of water shortages in the western states. It is not just the water coming in shortages that is affecting human health, but also the water quality decreasing. Waterborne pathogens are becoming more active waters, and due to the quick-and-heavy one time precipitation, human toxins and chemicals get quickly washed into fresh water reserves. Furthermore, changing water temperatures means that algal toxins and waterborne *Vibrio* bacteria will be visible in regions and seasons where it was non-existent before. This causes panic and unpreparedness in countries because they don't usually see waterborne illnesses (Crimmins et al. 2016). Health impacts to the decrease in water quality include gastrointestinal illnesses, effects on body's nervous system and respiratory system, or liver and kidney damage (Crimmins et al. 2016). The rate of people contracting waterborne illnesses will grow even higher as waterborne illnesses arise in regions where prevalence is unexpected.

It's not just waterborne illnesses that will have an impact on human health due to climate change, but vector borne diseases will also be on the rise due to climate change. These are illnesses that are transmitted by vectors (i.e. fleas, ticks, and mosquitos), and are made of pathogens such as viruses, bacteria, and protozoa. Usually ticks are only active in hot regions and at warmer seasons, but as temperature increases, the time period of the year in which ticks are active in certain regions is generally increasing, and the regions in which ticks are active continues to grow (Crimmins et al. 2016). The disease that many ticks carry

is Lyme disease, and it visible that Lyme disease has become more widespread, too. Warmer climates also affect mosquito patterns, for they tend like damp and warm environments. Furthermore, their hosts (usually birds) tend to be more prevalent in warm environments, and because the global temperature is increasing due to climate change, and the summer and hot seasons are extending longer, mosquito season tends to be longer and more prevalent too. With mosquitos, multiple vectors are spread, for mosquitos can quickly and easily spread diseases since they feed on blood. In fact, West Nile virus has affected an estimated 3 million people during 1999 to 2010 in United States alone (Crimmins et al. 2016). West Nile is a huge vector that is carried by mosquitos. Another recent vector that has been on the rise due to the heavy mosquito activity is Zika. Zika is very detrimental to human health especially to babies, for it can cause serious birth defects and neurological problems. The amount of vector borne illnesses is on the steady rise, and will continue to rise due to the growing global temperatures because that is preferential weather of many of hosts of these vectors (Crimmins et al. 2016).

In terms of air pollution, the trapping of heat in the atmosphere can make the air less healthy to breathe. Higher temperatures from the trapped heat due to climate change is highly correlated increases ground level ozone, a harmful air pollutant for us humans by causing damage to human lungs. This is due to the some of the carbon and nitrogen greenhouse gasses (nitrogen oxides and other volatile organic chemicals that contain carbon) react together to form ozone (O3). Ozone in the atmosphere helps humans by blocking sunlight, but ozone at the ground level can be detrimental to human health. Inhalation of ozone even at low amounts can cause chest pain, coughing, shortness of breath and throat irritation. Ozone

will also amplify allergies due to pollen in the atmosphere and aggravate other chronic respiratory diseases such as asthma and compromise the body's immune response to respiratory infections. The creation of ground level ozone is the major effect that greenhouse gasses have on climate change's creation of pollution, but climate change also induces natural disasters that create pollution. One of the natural disasters that is amplified and made to become more prevalent is wild fires. Exposure to wildfire smoke (a pollutant) can increase acute respiratory illnesses, and increase respiratory and cardiovascular hospitalization.

Another way that climate change affects health is its exacerbation of allergens. I have already noted that by producing ozone, climate change aggravates allergies, but climate change also affects the amount of time that allergies are in effect. Climate change effectively increases the atmospheric temperature and thus, creates a larger season for pollination. The greenhouse gasses produces also feed the plants to grow such as ragweed and other pollinators. In this sense, the effect of climate change is not only an increase in allergies in terms of length of the season but also the intensity of the allergies. Greater allergens also affect those that already have asthma and further aggravate their asthma condition. The increase in allergens in the atmosphere will also enhance exposure to children, which will in return increase the child's likelihood to develop future allergies and probable asthma. Therefore, in the future, it is expected that more and more portions of the population will have allergies and contract asthma.

In addition to allergies and pollution, climate change will increase the number of heat-stress illnesses like stroke. Climate change has been effectively making the atmospheric temperature rise and rise, and in coastal areas, the rise temperature is also increasing the

humidity content of the air. The humidity further increases the heat index (or the perceived atmospheric temperature). Especially at a child's age, a time with physical activity has much importance on the development of the child; the outside heat has become very detrimental to the health as it causes many cardiovascular problems including heat exhaustion and heat cramps. Furthermore, those that have existing cardiovascular or respiratory problems suffer even more from climate change's impact on atmospheric temperature. On the bright side, adaptation to heat has increased for many people, and this outweighs the potential for heat related illnesses and debases the statistics in the number of heat related hospitalizations per year. With the expected rise in global temperatures, however, the number of heat related hospitalizations will rise again. It's good to note that also even though statistics show that there hasn't been much change of heat related illnesses of recent, the health analysis of many hospitalization may explain the cause to be something different from the heat but due to another condition like diabetes. This misclassification really underestimates the number of heat related hospitalizations, so there is still a possibility that humans haven't adapted as effectively as they should. Nonetheless, there is a clear understanding of the physiological impact that climate change has on increasing the risk for stroke and other heat related detriments. Heat related illnesses, although not officially classified as such, may be the increase in cancer. Although not a direct link with heat, the depletion of the ozone in the atmosphere, which allows for more exposure to UV light radiation, has increased the likelihood of contracting cancer. Ozone depletion has recently been shown to be also caused by climate change because it heats up the causes cooling of the stratosphere, especially at the Arctic poles. This is because climate change causes evaporation of water by increasing up

the global temperature. The water vapor causes the stratosphere to cool and depletes the ozone (Kirk-Davidoff et al. 1999) . This depletion of ozone leaves the earth susceptible to UV radiation, which is linked to cancer. UV radiation causes cell mutation, and sometimes the cell mutations lead to a formation of cancer. In the case of UV radiation from the sunlight A study done in the early 2000's showed that not only UV radiation but increasing temperatures increase the probability of cancer. This study showed that when the temperature increases by 2 degrees Celsius, the incidence of cancer would increase by 21% and by 46% if the temperature increased by 4 degrees Celsius (Van der Leun and de Gruijl 2002). With global temperatures expected to rise about 5.8 degrees Celsius, the incidence of cancer should be expected to increase too. Without control of the UV exposure and the rising temperatures, the incidence of skin cancer, itself, is predicted to quadruple (Van der Leun and de Gruijl 2002).

In conclusion, the weather seems to be playing a huge role on affecting human health as a whole. It has created numerous problems to human health: from causing natural disasters, to fostering cancer and the spread of vector borne illnesses. Although not presently the major cause of mortality in most areas, climate change is becoming a bigger detriment to human health and the death toll will continue to rise if something isn't done to debase it.

Chapter 4: What Do People Know About Climate Change?

The severity of smoking's harm on the body, the symptoms of HIV, the inevitable harm of drug overdose, and the importance of keeping a diet would good nutrition. All these public health topics are pretty well versed in our society. In a 2001 poll, 71% of people indicated that smoking is the main cause of cancer (Cummings and Proctor 2014). In a study done on high school children in La People's Democratic Republic, most respondents knew that HIV can be transmitted by sexual intercourse (97.7%), from mother to child (88.3%) and through sharing needles or syringes (92.0%) (Thanavanh 2013). Similar statistical numbers of knowledge, attitudes, and perceptions are seen in the other public health issues as well. Climate change, however, is not as prevalently talked about in the public, and the knowledge of this topic may be misconstrued for some people. Before assessing the campaigns that are being implemented now, and trying to create a campaign for the public health issue of climate change, it is important to first understand what people know about the subject of climate change as an environmental issue and as a public health issue, and why aren't more people advocating policy for climate change?

The initial factor before people can enact their individual change or a group can practice their collective change is that people must obtain knowledge of climate change and its causes, and people must have an attitude that corresponds to taking action against climate change. So what are the statistics? In a poll done by Pew Research Center on 40 countries around the world, there is a huge disparity in the public's knowledge of climate change across the board continentally. In Latin America, a high percentage of people perceive

climate change as harmful. 74% of the public in Latin America say that climate change is a real problem, 77% agree that climate change is harming people now, and 64% are concerned that climate change will harm themselves personally. Latin America public responded with the highest positive output of the poll. The next highest were the public that lived in the countries of Africa. People of Africa responded as such: 61% say that climate change is a real problem, 52% agree that climate change is harming people now, and 61% are concerned that climate change will harm themselves personally. People that lived in countries of Europe constituted the next highest positive output of this poll. Russia and Ukraine, however, were not added to this poll. The statistics for the people in Europe are as such: 54% say that climate change is a real problem, 60% agree that climate change is harming people now, and 27% are concerned that climate change will harm themselves personally. In Asia/Pacific countries the statistics go as such: 45% say that climate change is a real problem, 48% agree that climate change is harming people now, and 37% are concerned that climate change will harm themselves personally. In the middle east, 38% say that climate change is a real problem, 26% agree that climate change is harming people now, and 27% are concerned that climate change will harm themselves personally. Now if we look at the two countries that produce the most CO2 emissions per year, US, and China, the statistics show a lot less of a positive output in polling numbers in terms of change knowledge and perception. In US, 45% say that climate change is a real problem, 41% agree that climate change is harming people now, and 30% are concerned that climate change will harm themselves personally. In China, 18% say that climate change is a real problem, 49% agree that climate change is harming people now, and 35% are concerned that climate change will harm themselves personally.

Although many of the countries of the world agree that climate change is a real problem, China and India make up 31% of the greenhouse gas emissions and the people of these countries show less than 50% positive output across the board. This is, however, a poll taken in 2014, and since the numbers have been slightly better, but it still holds true that the countries that have the highest CO2 emissions per capita (China and United States), are less intensely concerned about climate change (World Bank 2009).

These statistics show that all in all, 54% of the global population believe that climate change is a very serious problem, but these numbers are misleading because the people that mostly believe of this are people that come from developing and emerging nations that produce the least CO2 emissions per capita. For some of the more developed nations that produce the most CO2 emissions per capita, the majority of the population doesn't agree with the seriousness of climate change. Furthermore, what makes it worse is that some of the developed countries that produce high CO2 emissions and that don't agree with the seriousness of climate change like US also believe that developed countries even if they produce more greenhouse gasses shouldn't put more effort or do as much to combat climate change. This is daunting because it shows the lack of trust in the public to try to do something against climate change in these wealthier more developed nations. So why is this true?

Let's focus in on perceptions of the public in one of the developed nations: United States. It is first good to look at what people think is the reason behind climate change. Only about 48% of the adults in America think that climate change is mostly due to human activity, 31% of the Americans think that it is due to natural disasters, and another 20% of

Americans think that there is no solid evidence of warming (World Bank 2009). Furthermore, there is evidence that reveals that people's belief in climate change anthropogenic cause is not generally changing substantially over time. The public view that climate change is due to human activity only increased by 1% in 2014 from 2009 (Patz 2014). The possible reason why people don't think that climate change is due to human activity is because of the misconceptions that arise from the public's perception of scientists' beliefs. 97% of all articles from 1997 to 2011 take a position that is consistent with human-caused climate change (Patz 2014). Moreover, Pew Research Center survey of members of the American Association for the Advancement of Science (AAAS) found 93% of members with a Ph.D. in Earth sciences (and 87% of all members) say the Earth is warming mostly because of human behavior. The public does not think this, however, for only 27% of Americans say that "almost all" climate scientists hold human behavior responsible for climate change. Another 35% of the Americans think that more than half of the scientist agree that human behavior is the cause, 20% say that fewer than half of the scientist agree on this issue and lastly, only 15% believe that no scientists don't believe that climate change is caused by humans. These statistics show that although there is high trust in scientists and scientific data, the public has a warped understanding of what the scientists believe. This is probably part of the cause of why over half the Americans don't believe climate change has human origins (Reynold's 2010).

Therefore, probable reason behind the inaction to try to debase climate change issues is that the public does not find climate change to be an issue caused by humans and that there is thus, no need to try to limit themselves with climate change issues, but another reason is

that even though people know of climate change as a human cause, they don't think it is a dire concern in which action should occur for. It is also important to note that a staggering 36% of Americans are particularly concerned about climate change (Leiserowitz 2010). This is different than Americans thinking of climate change as an issue because this statistic looks at how many of the Americans care for the harm that comes from climate change and think that it is a concern for actions to be taken. Furthermore, American's who don't think that climate change isn't a real concern globally aren't trying to actively hear about climate change, and thus, inadvertently avoiding knowledge of climate change and its causes. Only a staggering 3% of the people who are not concerned about climate change follow climate reports very closely (Leiserowitz 2010). Therefore, those who don't believe in climate change is a concern, don't try to listen about the dangers of climate change that is occurring right now, and thus, aren't learning new calamities and natural disasters that climate change is causing.

There is a bright side, however. Despite having less concern for climate change, the public's willingness to support climate change is very high. On average around the world there is a 24% higher willingness for the public to support the country doing something for climate change than the public's concern for climate change. In countries such China, that produce high emissions and have low public concern for climate change, this differential is up to 50% (World Bank 2009). This, however, does not mean people are actively doing something to debase climate change, but support the country doing something. What may be a better way to compel people to believe in climate change as an anthropogenic cause and that it is a concern to make them to act in a way that debases climate change in the present?

Studies show that humans respond better when they have been personally affected by the stimuli or when they believe they can be personally affected by the stimuli. It may be that people will feel more concerned about the issue of climate change if they think of it as a public health issue (meaning that it can cause harm to human life) verses an environmental issue (or its impact on the environment). This means explaining climate change effects in terms of human danger. For example, instead of saying melting of ice caps and destruction of environment causing many animals to die, the dilemma would be melting of ice caps will raise sea water levels and cause many of the coastal cities where people live to be immersed in water, destroying not just the homes of many people, but also may kill many lives with its coming. It seems that, however, people don't perceive climate change in a public health concern, but rather for its environmental impact. This doesn't mean that people don't link the environmental impact to public health, but rather they see direct link between environmental harm and climate change. Usually this cause neglect in the public health side of the issue, as people tend to only think of the direct reason and not the overall resultant. In fact the most troubling potential across all nations surveyed in the Pew Research center, found that the most troubling or potential concern for climate change is drought or shortage of water (Funk & Kennedy 2016). Furthermore, in some countries, like Canada, only 9% believe climate change poses a risk to human health via infectious diseases (McAllister 2008). In a sense shortage of water is a public health impact, but this shows that most people see climate change in a more environmental outlook. In fact a research done in United States and Canada shows this.

In a survey done in Canada, 6 out of 10 people surveyed could tell a potential health risk when prompted about the health, but when asked about the potential health risk of climate change without any prompt, almost none could answer. Without prompt Canadian respondents believed that health risks from climate change include respiratory problems (22%), infectious diseases (11%), cancer (11%), air quality impacts (11%), and heat stroke (8%). When prompted, they responded by believing that climate change could cause respiratory and breathing problems (46%), sunburn (46%), and heat stroke (39%). This survey shows that many Canadians don't actually associate climate change with human health, but easily do when prompted. Only a third of Canadians, however, don't believe that climate change is a human health risk, and surveys conducted in 1993 and 2007 show that Canadians are finding climate change to be a higher and higher risk to health, for they changed ranking of climate change as a high risk from 27% to 35% (Malbach 2010). They rank climate change as only the third highest health risk in the nation just under air pollution and obesity. Canada tends to be one of the more active nations in trying to curb climate change. There could be a correlation between Canadians perception of climate change as a human health risk and willingness and actual actions against climate change.

In United States, surveys done in 2008 and 2009 showed that only 32% of the public saw themselves as being in risk for harm by climate change, only 35% thought their family would be in risk for harm by climate change, and only 39% thought their community was in risk for harm by climate change (Malbach 2010). Furthermore, in US climate change appears to lack salience as a health issue, for relatively few people were able to answer open-ended questions in a manner that indicated most-likely-associations between climate change

and human health risks. United States tends to be the a country that shows weaker support for climate change reform than most countries, and there may be a correlation between the country's lack of support and their belief in the actual dangers of climate change.

Although these were just 2 of the countries surveyed, across the world the public, in a top-of-the-mind manner, think of climate change in an environmental perspective, and don't directly link human health to climate change. Helping the public understand that climate change is more than just an environmental concern, but also a human health concern can maybe cause more support for climate change reform measures. Over several decades, cognitive research has been done to show that how people "frame" an issue (i.e. effects of climate change) has a great influence on how they understand the nature of the problem as well as what they think should be done on the problem. It is evident that climate change (as shown by US and Canada) is being perceived as an environmental issue, and that could be detrimental because this could distance people from the issue and contribute to the lack of serious and enduring public support and action needed to develop solutions. "This focus is also susceptible to the idea that the best solution is to continue to grow the economy and create adaptive measures when the society is wealthier and can afford to do so." This economic frame likely leaves the public ambivalent about policy action and works to the advantage of industries that are reluctant to reduce their carbon intensity as they worry about adaptive measures instead of the root cause of climate change (Maibach 2010)

It seems like there is global consensus that climate change is a problem, but how climate change affects the public seems to be knowledge that isn't as pervasive through the globe. It may best to disseminate information of climate change pertaining directly to human

health to ensure that solutions on climate change being created because people tend to respond better to situations that directly impact themselves. In chapters 5-7, I will explore what people are doing to curb climate change now and what could get them act more.

Chapter 5: What is Currently Being Done and Recommended to be Done?

In the face of all these dilemmas, in terms of public health and in terms of the environment, associated with climate change, what is currently being done and what is recommended? Essentially, the actions being done reside under two types of interventions: adaptation and mitigation. Adaptations are actions that are targeted at the system that may be exposed to imminent expected or actual climate stimuli with the goal of debasing or moderating harm from increasing. Mitigation is the limiting of global climate change by directly influencing the emissions of greenhouse gasses, and enhancing greenhouse sinks.

Firstly, adaptation is less on the prevention of climate change but more on the prevention of harm that comes from climate change. Whereas prevention of climate change indirectly prevents harm or mortality that comes climate change, adaptation directly affects or debases the harm or mortality. Although the other form, mitigation may seem better because it is more holistic, adaptation is just as important to develop because of, firstly, how greatly the extent to which that manmade greenhouse gases and aerosol emissions are already affecting average climate conditions and climate extremities as said in chapter 2 (Hegerl and Zwiers 2007). In terms of average climate (as noted in chapter 2), the 17 highest average global temperatures from the years 1880 to 2916 have come from the past 17 years (NOAA National Centers for Environmental Information 2016). Furthermore, for 2015, annual precipitation was just below average on balance for land-based rain gauges around the globe. Precipitation for 2015 was 22.5 mm (0.8 inch) below the 1961–1990 average of 1,033 mm (40.7 inches) (NOAA National Centers for Environmental Information 2016).

Furthermore, these small changes in average temperature will have huge impacts on natural systems that ultimately cause extreme natural disasters like alteration in El Nino patterns and extreme weather precipitations (i.e. blizzards, Tsunamis, Hurricanes, etc.) (Casassa and Rosenzweig 2007). Another reason why adaptation is important to implement is because unless extreme mitigation practices are being used (which is idealistic and impractical), the climate will continue to alter worse and worse for the foreseeable future. The global future forecast shows that the rate of global warming will continue to increase substantially for the time being due to the accumulation of the present greenhouse gases emitted in the past and the expected release of greenhouse gases to be emitted in the future (Meehl and Stocker 2007). Finally, adaptation is also used prevalently because of its quicker effectiveness, ability to be localized regionally, and its effects are less reliant on the actions of others.

So what are the properties of this adaptation action? One of the properties is that adaptation selectively is applied to certain systems and is not holistically geared to all systems. As I have noted before, adaptation works on the local to regional level of influence, and is quickly effective as it may immediately show efficacy. Adaptations also last a very long time, often have ancillary benefits, not necessarily have a cost on the polluter, and almost fully benefit the actor. Although it seems that adaptations have very many positive factors that support its implementations, there are certain properties that are negative. One of such is that adaptations tend to be very difficult to monitor. Another negative property, which is definitely a very serious disadvantage, is that it is generally less certain that adaptations will yield the proper and expected effects. Although some disadvantages exist with adaptations, it is definitely an action worth exploring and implementing.

Before giving examples of adaptations that are implemented in the present, it is important to discuss the multiple dimensions that give rise to the variety of implemented adaptations. One dimension of adaptations is the type of climate hazard that it is geared to help. The adaptation needs to focus on that hazard, whether it's a blizzard or a drought. Another dimension is that an adaptation also affected by non-climatic conditions such as political, economic and social conditions of each region. Next, adaptation carries a dimension of purposefulness, or whether the action in autonomous or purposefully planned. A dimension of adaptation also related to this is timing, which encompasses whether the adaptation is a proactive measure or a reactive measure. Planning is also a dimension of adaptation that describes how much time it takes for the creation of the infrastructure of the adaptation. Lastly, adaptations also involve the dimension of the implementer's role, for there maybe many implementers that are involved of different socioeconomic statuses, and their socioeconomic status is very important for the enactment and success of the adaptation.

There are ultimately many forms of adaptations to anthropogenic climate change that are in play at the present. These adaptations include disaster risk management, coastal management, resource management, spatial management, urban planning, agricultural outreach, and public health interventions. Disaster risk management is a program that aims to reduce the impact and damage caused by natural disasters that are induced by anthropogenic climate change. This includes early warning systems, and, although very related, it is important to differentiate this program with another form of adaptation called coastal management. Coastal management also decreases the impact of natural disasters but instead of relying on dissemination of information, it is a direct defense on natural disasters that

cause harm to the land like structural protections and levies. Resource management is the efficient dispersal of resources when and where they are needed. Examples of this are water allocation during droughts and FEMA programs in the aftermath of hurricane disasters. Spatial management includes programs with recognizing areas that are more risk prone to natural disasters and plan to effectively help areas that are risk prone like flood zone protection of coastal areas that are below sea level. Urban planning has to do with planning the urban infrastructure of a city to gear itself to the expected climatic extremities that it will be exposed to. Such adaptations include building codes. Agricultural outreach or extension is the application of scientific research in agricultural practices in order to combat climatic extremities like drought. Furthermore, this type of adaptation focuses on the dispersal of this scientific knowledge in the agricultural world. Such adaptations include seasonal forecast and combating crop parasitism. Lastly, there is public health, which deals with monitoring, regulating, and promoting the health of the population as a whole. This can include disease surveillance systems, sports recommendations or regulations to minimize heat related injuries due to the general increase in temperature of the climate (Willows and Connell 2003).

The systems listed above are the major types of adaptations being implemented right now, but it is also good to not the flexibility of each practice. These adaptations aren't just stagnant, however; in order to combat the continued change in climate, adaptations have to be just as fluid. Therefore, there is an aspect of adaptations that is called adaptation planning, which has to do with assessing the situation (if there is a adaptation already in existent,

assess the efficacy of the program, and if there isn't one, assess what works best as well as what is needed), and organize a system that can be implemented to combat the dilemma.

Overall, the above adaptations work to ensure short-term relief. Mitigation, however, works to reduce the effects of climate change overall in a non-localized manner. This is more of a holistic approach, and works on prevention of the problem in the first place. Just like adaptation, it is important to talk about the main properties of mitigation. Mitigation of climate change targets all systems of climate change. Climate change, the increase in average temperature of the world and the extremities in climate patterns caused by such, is engendered by the creation of greenhouse gasses. Mitigation directly deals with decreasing greenhouse gas production as well as use various sinks to combat these greenhouse gases (nitrogen, methane, and carbon dioxide) to stop the temperature rise. When inhibiting the temperature rise, the climatic extremities also become inhibited, and thus, that is how mitigation works to target all systems in relevance to climate change. The scale of effect of mitigation is much larger than adaptation as mitigation is geared to help climate change as a whole by effectively decreasing the global temperature and thus, this group of actions has a influence more nationally to globally. Furthermore, mitigation is not only long-term but it will be an action that will resonate for centuries. It's relatively easy to monitor because there is not much change that needs to be assessed after the mitigation actions have been implemented; rather, only maintenance needs to be implemented. We do know unlike adaptations, that mitigation actions will ultimately be certainly effective (Fussel and Klein 2006).

Although mitigation seems to be a group of actions that are very useful and extremely optimal to implement, there are some disadvantages. One of the disadvantages is that it may take a really long time for the mitigation interventions to show its fully efficacy (Bellard et al. 2007). This is not only because the practices must be carried out globally to take on the full global effect, but also because of the vast amount of greenhouse gasses already produced, which will take a long time to make up for. Furthermore, there may be heavy opposition within the polluter groups because they have a high cost (usually because they have to limit wastes and carbon byproducts that result from their manufacturing), and this opposition may intervene in the process of implementation of mitigation actions (Bellard et al. 2007). Another disadvantage is that, in essence, the actor can only produce a little benefit, meaning that by oneself, not much effectiveness can be produced, but only with collective support will the efficacy of mitigation actions shine (Bellard et al. 2007). In that sense, the benefit one reaps is dependent on the actions of others as well. This dependency may cause the implementation of mitigation programs really difficult because the lack of results due to incomplete utilization by everyone in the collective.

Despite these, mitigation still hails as very important to implement because of its basis of reducing the root cause of climate change, and thus, effectively showing long term lasting benefits. Furthermore, as a wholesome system, instead of localizing to one problem, it will effectively decrease the impact of many problems at one time. Finally, most mitigation programs rely one limiting greenhouse gasses in the atmosphere, and that is relatively easier to monitor than assessing adaption programs, which use more subjective assessment

strategies. This method also reduces vulnerability to future climatic problems globally instead of just locally, and thus, protecting more lives.

So what are some of the mitigation programs that are being implemented presently? There are 7 sectors for mitigation technologies should gear towards, and to certain aspect are geared towards, and these are: energy supply, transport, buildings, Industry, agriculture, forestry/forests, and waste (Ackerman et al. 2007).

Let's start with the energy supply sector, the sector that seems to produce the most greenhouse gasses, where 30 percent of the CO2 emissions produced are created by production of energy (mainly electricity and heat) as of 2004, and if not regulated further, there is expected to be an increase in CO2 emissions by this sector by 1.8% a year. Presently, what is being done is improved supply and distribution efficiency, fuel switching from coal to gas, some nuclear power, renewable heat and power (via solar power, wind power, geothermal power, bioenergy, and hydropower), and early capturing and storage (CCS) of CO2 before emission (i.e. storage of removed CO2 from natural gas). What needs to be implemented is that not only natural gas CCS should be made, but CCS also needs to be utilized more for biomass and coal-fired electricity generating facilities, advanced nuclear power, advanced renewable energy (tidal and wave energy and more concentrated solar energy). It is expected that these future implementation will be developed for use by 2030, and if fully implemented, these actions may produce an average mitigation potential of 2 to 5 GtCO2-eq/yr. This means a deviation in the expected greenhouse gas production by 2030 by 2 to 5 gigatons of CO2 per year. As seen, this sector has a huge impact on limiting greenhouse gasses in the atmosphere, but it is not the highest (Change 2007).

Next let's assess transport mitigation actions, which is the second most. In the present, creation of more fuel-efficient cars are being created such as hybrid cars, fully electric cars, more fuel efficient and cleaner diesel vehicles, usage of biofuels, modal shifts from cars to transportation using rail and public transport systems that transports multiple at a time. Furthermore, more non-vehicular transportation (i.e. cycling, and walking) and transportation planning (i.e. carpooling) is being implemented (i.e. cycling, and walking). By 2030, a more efficient second-generation biofuel, higher efficiency aircraft, and more advanced electrical and hybrid cars with higher power batteries is expected to be to be created. Climate change mitigation in terms of transportation is expected to yield a decrease of 1.5 to 2 GtCO2-eq/yr by 2030 if policies and technology furthers as planned (Change 2007).

In terms of building energy usage, mitigation actions implemented presently include efficient lighting and day lighting; more efficient electrical appliances (including AC), improved cooking methods and insulation, usage of solar designs actively or passively, recovery/recycling of fluorinated gases, and alternative refrigerator fluids. In the future, technologies and actions of mitigation that should be further implemented include more advanced tools that enable assessment of building materials and building infrastructure so that we may assess and create a more green and insulated area, and solar photovalics integrated into buildings so that more green solar energy can be used. This sector seems to yield the highest mitigation potential, which if all policies and conservation actions are being utilized will give a decrease in CO2 emissions by 4.5 to 6.5 GtCO2-eq/yr. This shows there is a high inefficiency of CO2 emissions in this sector. Mitigation in this sector is not only

reliant on changing technologies. Even though most of the energy being saved in the sector seems to be through the usage of new innovative technologies, other mitigation interventions can occur on the individual and this includes efficient usage of electric appliances and light around the home.

In the industry sector, mitigation actions that are occurring in the present include heat and power recovery, material and cycle substitution, control of non-CO2 gas emissions, and more efficient end-use electrical equipment. Things that can be done to further help with the mitigation of climate change is more advanced energy efficiency, CCS for cement, ammonia, and iron manufacture, and inert electrodes for aluminum manufacture. This sector there is much importance in not only decreasing the CO2 emissions from the industry as well as decreasing pollutants from Nitrogen emissions (which has more global warming potential than CO2), and aluminum pollutants. Mitigation not only decreases the potential for climate change but also decreases the pollutants that affect our health. Thus, showing that this sector is important to better human health in directly via the pollutants and indirectly via the emissions that affect climate change, and thus affect our health. If interventions of this sector are properly implemented, a high mitigation yield will occur, and there may be a decrease of .5 GtCO2-eq/yr to 5 GtCO2-eq/yr (Change 2007).

The next sector is agriculture only takes up 9% of the Greenhouse gas emissions, but still can still be altered to mitigate climate change, and effectively help reduce CO2 emissions globally. Mitigation actions in this sector that are occurring right now include improved crop and grazing land to increase carbon storage in the soil, which will decrease the amount of CO2 emissions in the air. Furthermore, mitigations that are being implemented

as well include the use of rice cultivation techniques and manure/waste management, and the use of increased fertilizer application techniques. These interventions decrease methane and nitrous oxide emissions respectively, which, as stated in chapter 2, are emissions that produce much more of a global warming potentials than CO2 emissions. Lastly, other interventions that are being implemented is that there are crops being grown to replace fossil fuel usage (a huge greenhouse gas source), and improved energy efficiency to cultivate groups. Future interventions in this sector to mitigate climate change are more research to improve crop yield, and more efficient consumption of crops to reduce waste that become pollutants (although this last one may also be an intervention in the waste sector). At the minimum, the interventions could reduce greenhouse gas emissions from expected potential by .5 GtCO2-eq/yr, and at its maximum could reduce them by 6.5 GtCO2- eq/r.

The next sector, forestry/forests, yields an even lower percentage of the global CO2 emissions, but, just like agriculture, has a high potential to decrease the effects of climate change. Currently implemented mitigation techniques include reforestation (try to cultivate forest and regrowth of the forest in previously cut down forest by replanting the area with trees), afforestation (convert land not previously a forest into a forest), reduced deforestation, and use of bioenergy products in the place of fossil fuels. Future recommended interventions include tree species improvement (via genetic research) to produce trees that have higher biomass and can forcibly reuptake or store CO2, and increase in technologies that would be able to effectively assess the carbon reuptake and storage potential of CO2. By 2030, interventions in this sector effectively has the potential to decrease CO2 emissions by .5 to 4

GtCO2- eq/yr, which has a wide range, but still has the ability to produce a large amount of mitigation potential.

Lastly, there is the sector of waste that usually pertains to the greenhouse gas of methane. Interventions in this sector that are currently being done include landfill methane recovery, waste destruction with energy recovery (because if not the energy from incineration may produce further greenhouse emissions), control wastewater treatment, recycling to reduce waste, and organic waste composting. In the future, mitigation practices that are recommended include increasing the recycling efficiency and creating better bio-filters that will filter the methane that has polluted the water by oxidizing the methane a very powerful greenhouse gas (Streese and Stegmann 2003). By 2030, if implementation of these practices occurs, only about 1 GtCO2- eq/yr will decrease, but is still very important because the individual such as recycling and reusing to reduce waste can implement much of this sector. Furthermore, there can be a lot of waste management on the personal level by reducing over consumption of water (water over consumption causes need for costly and waste producing water purification techniques) and food (Change 2007).

It is good to note that in each of the sectors the mitigation potential described is an estimation of what would happen by 2030. Furthermore, it is good to note the minimum is based on the lowest amount of spending for the intervention but has a potential to grow to the maximum due to an increased spending on the interventions.

It is also important to note these interventions seem like wholesome interventions that are implemented by the nation, but they are also options that can be implemented by the individual. As I have noted before, recycling and reusing are easy but effective methods that

can be used to mitigate climate change. Furthermore, two of the highest contributors to greenhouse gasses are the transportation sector and the energy sector. An individual may reduce the effects of these sectors by carpooling, using public transportation, utilizing more fuel-efficient cars or electric cars, conserving energy (i.e. using sunlight instead of electricity, turning off appliances when not in use), and utilizing sources of renewable energy. Although not as affordable at first, in the long run using sources of renewable energy (i.e. solar energy, wind energy, hydropower energy) is cheaper because of lower electricity bill per month due to the power being self surfaced by system that gain energy from the sun, wind, or water (this is also the case for electric cars because of lower fuel costs). Of course, only in certain areas and at certain seasons do some of these alternative energy sources help. There are other efficient energy options that will help mitigate climate change as well such as switching to natural gas. Natural gas is presently cheaper than coal and produces half as much carbon dioxide per unit energy compared to coal.

Mitigation and adaptation are both programs that are very useful in producing results in decreasing harm from climate change. Although they both have different influences (i.e. one influences by directly impacting people and environment by protection from climate change issues, one influences the cause of climate change and deals with the prevention and diminishing the effects of climate change), they both go hand in hand. It is important to integrate the two actions so that they complementary. Adaptations and mitigations have the possibility to be complementary (i.e. water allocation in periods of drought as an adaptation and limiting water consumption/reducing greenhouse gas emissions that cause the climate to change and induce global warming as mitigations) or they could be contradictory (i.e.

adaptation: using ac in hot temperatures, which produce greenhouse gasses; mitigation: trying to reduce greenhouse gas emissions). It is important to then increase the number of adaptations that complement mitigation strategies and minimize contradictory adaptations in order to debase climate change (Ackerman 2007).

Lastly, the most important thing that is being done to prevent climate change is dissemination of information that is pertinent towards the benefits of climate change. It is also important to express the detriments of climate change and explain how they are imminent on present day society. Furthermore, it is important to spread information that expresses the ease at which each type of mitigation actions can occur such as recycling and reusing. This is a topic that will be further discussed in the next chapter.

Chapter 6: Are People Taking Actions and If Not, Why?

The trans-theoretical model was introduced by Prochaska and Velicer in 1997 and posits that practicing a particular health behavior change involves progressing through six stages. Half of those stages encircle the idea of knowing the problem but do not actually make the health behavior change, and these stages include pre-contemplation, contemplation, and preparation (Prochaska and Velicer 1997). Lets take mitigation of anthropogenic climate change as a health behavior change. As discussed in chapter 3, there are many people that know of the harms of climate change, and they know that humans are a supplementary cause of its severity, but are people taking actions? There are still many people that are not taking action despite their knowledge of climate change, and it seems like they are in one of these three stages of health behavior change. This chapter will discuss whether people are taking actions against climate change, and why are those not taking actions?

Instead of looking at the individual, let's start by looking at internationally what countries are doing in taking initiative to curb anthropogenic climate change effects via mitigation. Internationally, it seems that there are 3 main convention/agreements that have been implemented to debase climate change by mitigation of emission of greenhouse gasses. I will dissect these three conventions to assess whether the internationally are countries taking actions against climate change. The first conference that really expressed importance to curb climate change is known as the Framework Convention on climate change in 1994. All they countries in the convention agreed there needs to be an agreement with stricter demands for reduced greenhouse-gas emission policies.

In 1995 they started negotiations on the Kyoto protocol, which was initially adopted by 1997 and had been set to full motion in 2005. A total of 192 countries signed or ratified or accepted this agreement to keep greenhouse emissions 5% lower than 1990 atmospheric greenhouse gas content for each country that is developed (some countries have stricter standards; i.e. EU has to keep 8% lower). Utilizing strict financial penalties on countries that do not reach this standard enforces this (Protocol 2011). Unfortunately, the top three countries that produce the most greenhouse gasses are not being enforced to follow this protocol or they have not agreed to be part of this protocol. These three countries are the developed country, United States, and the developing countries of India and China. Furthermore, Canada had noticed their failures to keep up with the emission standards and dropped out of the Kyoto Protocol. Furthermore, there has been a he failure with the Kyoto Protocol in debasing the overall greenhouse gas emissions, while may have worked among many developed nations in Europe, has not a good job globally because its policies address mainly countries that only have a sliver of affect on the greenhouse gas emissions, and it fails to affect those countries that produce the majority of emissions. The Kyoto protocol did have one advantage, however, for it showed countries around the world the importance of controlling greenhouse gas emissions as well as initiated the some countries to already be more green (Grubb et al 1997).

The next agreement that took place in order to attack the problem of climate change was the Copenhagen Climate Change Conference at the end of 2009, where 111 industrialized countries expressed support for an agreement called the Copenhagen Accord. In this agreement, it was agreed that the countries will work together in order to keep the

overall global temperatures below an increase of 2 degrees Celsius, both developing and developed countries that have signed off on the accord will take actions to reduce there climatic change atmosphere pollution, the countries will report their emissions and commitment efforts to reduce the pollution every 2 years, will raise money to provide support against deforestation, which accounts for 15% of the pollution, and the countries will pledge to raise 30 billion dollars that will be used for clean energy development/deployment, deforestation, and adaptations in developing nations over the 3 years since the agreement of the Copenhagen Accord. Furthermore, developing countries will increase their assessment and report of pollution reduction, and will receive support and help from developed countries to debase concentrations atmospheric greenhouse gases (Bodansky 2010). All in all, this agreement seemed to be looking up, but frequently it has been known that many countries have failed to meet up with the standards and regulations. Furthermore, it isn't as strict on the leading three nations of greenhouse gas emissions (India, China, and USA) because they have convened with each other rather than talking with the whole group of nations in Copenhagen. Still, this conference showed promise as it had convinced 35 developed nations to instill their efforts to control climate change, and 41 developing nations as well (Houser 2010). Before this agreement, there wasn't really substantial pollution control agreement for the developing nations (take Kyoto Agreement for example).

The next agreement made to address the issue of climate change was the Paris agreement, which made up for the downfall of the Copenhagen Accord (that the top 3 polluter nations weren't really implemented into the agreement). This agreement was vastly stricter than the past two agreements. In this agreement, there is also a limit of a 2 degree

Celsius (if 1.5 degree Celsius is not possible) increase in the next century (Fawcett 2015). Furthermore, this agreement will try to turn developing nations to develop at the expense of producing greenhouse gasses because in the long run, when developed, the greenhouse gas production will be reduced due to more green energy development (developed countries have enough resources to implement more green energy). In addition, this agreement will develop mitigation practices, improve technology that deals with sinks, and implement public health initiatives that deals with epidemics that have risen from climate change and increase awareness, implementation, public anticipation, and education about climate change. Overall, two of the most polluting nations have committed to helping reduce greenhouse gas emissions, and work actively to improve greenhouse gas sinks (China and India). In fact, China and India have taken some of the biggest initiatives to curb climate change. Initially, USA had committed to the Paris Agreement in September of 2016, but unfortunately it seems as if with the new presidential administration, climate change policy in America will be a thing of the past (Fawcett 2015). This is extremely bad because US emits around 16 of the total CO2 equivalent greenhouse gasses, and with the new administration removing many of the Obama-era environmental rules an regulations. Lastly, the new administration plans to almost abolish the EPA, the agency responsible for regulating intra-national pollution causes in the USA. Although, USA seems to be taking a step away from climate change control and regulation, another superpower, China (which produces around 28% of the global CO2 equivalent emissions) is taking lead in climate change control. China uses a vast amount of coal and has agreed to decrease coal consumption by 80 million tons by 2017 and 160 million tons by 2030 (Fawcett 20115).

All in all, in terms of a global scale, are the nations trying to actively reduce climate problems in the present? Globally, a lot of actions are being done to protect the atmospheric concentrations of greenhouse gasses by the most emission creating nations. However, there are still some nations that aren't involving themselves in debasing climate change (such as USA). Furthermore, there are some developing or emerging nations that are not putting a huge effort into curbing climate change. Why are some countries not being more involved in the curbing of climate change? When it comes down to it, there is a huge cost when controlling climate change by reducing greenhouse emissions, increasing sinks, and developing more protocols to curb climate change. In an article from 2009 by The Economist, a world bank noted that "poor and middle-income countries already contribute to over half of the total carbon emissions." As developing countries keep growing and develop, they will continue emit more and more carbon from fossil fuels. In developing countries, the infrastructure and technology is not advanced enough to break the chain that binds economic growth, poverty rate, and national development to CO2 emissions. As the country develops to increase economic strength and provide jobs, the country becomes more industrialized and uses more fossil fuels; thus, producing more carbon emissions. In fact, studies show that poverty has an inverse correlation with carbon emissions. In developing nations of East Asia and the Pacific, the number of people in the poverty bracket has decreased 85 percent, from 1.1 billion people to around 161 million within the years of 1981 and 2011 and carbon emissions have increased by 185 percent (that is 2.1 tons to 5.9 tons) in the same time frame. The same patterns are visible in South Asia and Sub-Saharan Africa in the same thirty-year period. In South Asia, extreme poverty decreased by 30% and carbon emissions have

increased by 204%. In Sub-Saharan Africa, the same pattern is shown, but in the opposite path. Poverty in this region has increased by 98 percent, and carbon emission per capita has decreased by 17 percent. Although not the direct cause of a decrease in poverty, it seems as if that burning fossil fuels and emitting carbon into the atmosphere is causing the country to be more developed economically, and thus, removing people from the poverty level. It seems like the only way to get these poor or middle income countries out of their economic slump is by industrializing them more in spite of the cost it has on carbon emissions. Furthermore, as these countries try to develop they tend to create more of a hazard on the climate, and studies show that the climate change has the hugest effects on these low and middle-income countries. This causes the country to expend even more fossil fuels to either cleanup the aftermath or try to develop their country to adapt to these climatic hazards. There is, however, a way to overcome this obstacle and that is to get the developed nations to help overcome their economic disadvantage by developing these countries into developed nations. Instead of the developing countries using cheap globally harmful resources and ultimately developing infrastructure in that manner, it would be better for the developed nations to ensure that these developing nations create a more green infrastructure as they become developed because they can afford it. Not only will this help the developing nations become greener for the long run, but will help them economically in the long run because many of these green resources are financially more efficient of an energy source.

If the future looks promising if certain measures are taken, why are no countries doing so then? This is because, in a global scale, there is not enough of a strict structure of rules to keep nations from wanting to support their selves and serve the people within the

country in more publicly perceived urgent issues (Giddens 2009). On that basis, it may be better to see which countries are acting in a national level in a way that would prevent them from participating in global climate change plans, and this may help us answer why actions against the effects of climate change effects seem so ineffective. Many of these nations that are the least active in the fight against climate change or unsurprisingly the nations that produce the strongest aggravators to anthropogenic climate change. Among these countries, are some of the most developed and wealthy nations like United States, Japan, and China (although China and Japan are starting to develop greener actions and fight against climate change).

Let us look at US in particular. Why isn't United States in particular not doing much globally and nationally to curb climate change? One of the reasons is the urgency against climate change. People don't find an urgent reason to look at climate change as stated in chapter 4. Climate change is numbered very low in the public agenda for the country to be addressing. There seems to be no public perception of the human health harm that may come to climate change. As I have explained in chapter 4, since barely anyone thinks of climate change as a human health concern, it seems that climate change will ultimately not be in the top five agenda items on American public's mind, and if not on the public mind, it will definitely not be on the national government agenda. Furthermore, the era in which we live in pushes climate change further down on the agenda. The biggest issue is the economic climate that has been reverberating through United States in general. Conserving jobs, ensuring medical care, ensuring that the economy doesn't break down, and keeping people away from poverty seems to be the most pressing matter. Fear from the economic regression

and turmoil of the later Bush era, seems to instill economic fear in the individuals of America, and causes them to worry about the economy of America rather than the possible harm of climate change. Furthermore, since there needs to be some capital needed to invest in greener resources to curb climate change or capital in general needed to combat climate change in whatever method, it seems expensive in this time of financial worry. Instead investing in more pressing matters (i.e. creating jobs, and fighting off terrorist that may have immediate harm) seems to be the more efficient use of the money in fighting climate change (McCright and Dunlap 2011).

In addition, it seems as if climate change is not seen as urgent because of the unruly political battle that is portrayed to the public about climate change. Since conservatives and liberals in United States are tending to become more and more polarized, it is becoming more and more prevalent that these groups fight and disagree against each other on every political topic, and that includes climate change. The public sees this constant bickering constantly by the media (who themselves amplify the polarization of the issues), and begun to distrust the political leaders of each party and their views. For those who are proposing climate change is a real issue in a scientific manner, this is daunting because politicization of this issue has caused unrest and distrust of this issue among the public. Even the scientific explanation has been overruled. Because of the distrust, people continue to see climate change without the urgency it needs. Furthermore, those who are on the side against climate change actions (i.e. mostly conservatives against climate change for economic reasons) propose wrongful information on the causes of climate change. This wrongful information and continuing

bickering together cause people not to see climate change as an urgent manner (McCright and Dunlap 2011).

In conclusion, much is being done to combat climate change currently, but efforts seems to not look as effective because the countries that are the leaders in aggravating climate change aren't doing much to debase the problem. It is not just the government's fault that these countries are relentlessly doing little to help fight against the issue at hand, but the public for they are conflicted and don't see climate change as a real and urgent issue. Without the public to back the government, the nation can't do anything not just intra-nationally but internationally as well. In the next chapter, I will conclude with a campaign that may help fight against climate change.

Chapter 7: A Campaign for Success

Before making a public health campaign that will best help diffuse the public health problem of anthropogenic climate change that will undeniably put so many people at risk in the imminent future, it may be best to initially analyze into past health behaviors/epidemics and their corresponding successful and failing public health campaigns. This way a public health intervention can be made to gear to the advantages and successes of these campaigns as well as improve on the downfalls of the campaigns.

Firstly, it is important to note for the most part it is hard to reproduce certain concepts of past epidemics into new public health campaigns because climate change is such a different topic in comparison to past topics, and different variations of the successes of some of these campaigns must be made. Only the broad over-arching motifs may we reproduce from old campaigns. It may be very well true that some of the specifics can be reproduced, but it is uncertain how successful it can be. For example, heavy taxation of cigarettes worked very well, but this was due to the acceptance of the tobacco as negative drug that causes bad side effects, but reproducing this to climate change could be detrimental because climate change isn't seen as a relevant and more urgent issue to deal with. This would just cause public disapproval of more actions as climate change. Therefore, broad motifs must be looked at first, and then implementation of some specific motifs could be integrated.

Looking at three major types of campaigns, anti-drug, anti-smoking, and anti-AIDS campaigns has revealed six common motifs in promoting norm change in the individual setting. These include the implementation of a wide range of different actions must be taken

(Barokas 1995). A wide range of different actions keeps the public interested and anew so that common teachings can continually be shown to the public. Another common motif includes attracting celebrities to stimulate the norm development, which would better amass the public to listen (Barokas 1995). Furthermore, another common theme is that perceptions and misconceptions have to be corrected by confrontation with reality to better dispel the misconceptions. In addition, another theme is that there needs to be clarification of risks provided when acting in dangerous behaviors. In this sense, truth is very important, for it is ok to say that there is meager risks in the beginning or if there are only a few mishaps, but undue alarm has to be raised for increased repeated denial or wrong actions (Barokas 1995). Moreover, another theme that is common in the success of these three major types of campaigns is that groups need to be reached out to specifically whether it's a political group or an age group (Barokas 1995). When a group is reached out to, it will understandable have aspects that synchronize better with that group, and thus, will be more connective to the group as well as make the campaign more effective as people will respond well for being recognized. Lastly, legislation, taxation, and enforcement must happen over time after social norms of the topic are better geared to support these actions (Barokas 1995). At the very least, a minimum must be implemented, and as social norms grow so do restrictions. Only when things become more severe to the government, can the public view the severity of the issue and respond accordingly.

Ultimately, by looking at old campaigns, we are able to understand that when building a campaign to combat climate change on a national level, we must first attack social norms and create an environment that believes that actions against climate change is a social

norm and not just what the government is pushing. A campaign must have clarity, be linked to social values, and presented with clear sanctions. Not to get carried away, however, but I will look more into a national level campaign at the end of the chapter.

In any case, what type of campaign would be able to effectively move the masses to act against climate change? In a campaign to debase the effects of climate change, in my opinion must have a two-tier approach: one with government involvement and one that involves spreading knowledge to the public. It would be best to start with the spreading of knowledge to the public because unless public fully supports policies against climate change, governmental policies will fail to work. The best way to obtain public support is to spread knowledge of the importance of climate care.

In a campaign that tries to move the public to support climate care, there also must be multiple parts: there first needs to be research done to see what groups respond best to what campaigns. A research done by Leiserowitz in 2006, demonstrates that messages about climate change need to express the urgency of climate change more definitively because, as in America, people don't generally see climate change as an urgent risk but more of a moderate risk that remains low priority in comparison to other national and environmental issues. This research, however, also demonstrated something more important: that messages to the public about climate change must be geared to the "needs and predispositions of particular audiences; in some cases to directly challenge fundamental misconceptions, in others to resonate with strongly held values" (Leiserowitz 2006). For example, as I have said in the last chapter, there are many of those who don't trust scientists, so using a scientist to explain the dangers of climate change would be very destructive and redundant because they

wouldn't listen or trust what the scientist says. Therefore, research must be done to assess the correct form of disseminating the information to tailor to that group of people. A correct form could be using a celebrity, a trusted politician, or a popular civilian in that community. This is just one example, but there are many more groups that have differing opinions on climate change and need to be tailored to. It may be good to use the theory of planned behavior in order to research how to cater to each group of people. The theory of planned behavior looks at people's attitude towards climate change policies and actions, the subjective norms that arise around the idea of climate change policies and actions, their behavioral intention behind acting to rectify the problem of climate change, and their beliefs in self efficacy of their actions. Behavioral intention would look at the perceived likelihood of preforming a behavior like using attitudes of the situation to understand if people would likely act in mitigation actions against climate change. By assessing this we would be able to assess which groups need more emphasis on a different type of program to get them to act against climate change, and which of those wouldn't require much deviation from the current plan of action. People are rational, so they think about the results of their decisions before they make it. If they believe a certain action like limiting electricity usage will have an impact on mitigating climate change, they will more likely follow through on it. In terms of subjective norms, the TPB looks at what people believe about other people's beliefs about climate change actions and what the stigma they create around these actions. Furthermore, looking at subjective norms also looks at what people's motivation in listening to are, and we would follow up with these norms that are created by the community. This part of TPB would help make the face of the campaign at a region because it would allow us to

understand who has a high influence in that society. Self-efficacy is also a very important to look at because we should try to understand why those who believe that they don't think they themselves could pull off the behaviors against climate change. By adding research on this point, we can fully make a policy that helps people feel effective in their ability act against climate change. All of these concepts together should not be researched or garnered to meet the needs of the whole population, but should be used to make separate policies to different groups.

Of course, this research will take some time, but there shouldn't be idle action during times of research. Campaigns should already be starting that take into account groups that have already been researched, and have an opinion on climate change like campaigns that cater to liberal and conservative groups. The research should occur simultaneously with the current campaigns. Furthermore, research should not be stopped after creating campaigns because opinions beliefs of people are constantly changing and are very subjective. What campaigns should be made now that will cater to current groups like conservatives and liberals? As I have stated in chapter 6, conservative groups consists of highest opposition to climate change actions because of multiple dimensions. Some of these include group polarization (i.e. since people in their own group tend to have their beliefs amplified due to what peers are saying in the group after discussions or social gathering), economic belief that climate change actions are costly, desire to oppose the other side, being fed equivocal information about climate change, lack of perceived urgency on the topic, and general mistrust of scientist. To face this dilemma, campaigns must directly solve these issues. A lot of mass media has a huge influence on how conservatives arrange their views. For example,

in a February 2007 Fox & Friends (a conservative network) segment titled, "Weather Wars," James Inhofe deceptively argued that global warming was in fact due to natural causes and mainstream science was beginning to accept this conclusion. Furthermore, he said "those individuals on the far left, such as Hollywood liberals and the United Nations," want the public to believe that global warming is manmade (Nisbet 2009). Conservative supporters will react to this wrongly fed information, and continue to become polarized to the conservative side because they think that the reason behind liberal arguments is because of contention between the two political groups, and not because of the science. Furthermore, it seems as if the actual comment about the liberals was made in opposition to liberals as a political destruction of liberals. Although this quote is one sided (conservatives), it is good to not there is mutual treatment by liberals. In order to debase this situation, a campaign that takes both sides into account and is less bipartisan will help create support of climate change on a conservative standpoint because it will appear less attacking to either side. It is important to ensure that the campaign given is also not an over dramatization because it makes it seem that arguments of climate change are untrue and may actually be over exaggerated to the point of it being a lie. Furthermore looking at the quote it seems like the message that is given just has wrongful information, and it is good to ensure that in a current campaign, discounting wrongful science information as false is paramount. The wrongful information given by James Inhofe about increasing number of scientists believing that natural causes was the main cause of climate change also serves to confuse the listeners and make them distrust the climate scientists at all. Lastly, in a campaign to conservatives, there must be some implication that actions against climate change can be economically efficient.

The biggest argument that those who oppose climate change actions have towards climate change is that climate change seems to be an economic obstacle and thus, isn't necessary to deal with when there are other issues like job security to worry about. An example is framing the campaign is to emphasize opportunity to revitalize the economy by investing in new clean energy sources because it creates jobs and is cheaper in the long run. It is good to ensure that the campaign has key catch phrases metaphors, sound bites, graphics, and allusions to history, culture, or literature that may help many of those who oppose climate change actions see the economic advantage in climate change policies and actions against climate change (Gamson and Modigliani 1989). For example, catch phrases like "creating green jobs" works to involve climate change with economic development (Nisbet 2009).

In any case, using the mass media effectively is very important, and one of the ways it can be used is ensuring that climate change actions or actions to combat climate change is the normative behavior (Barokas 1995). Using mass media to show that this norm already exists will make them feel more compelled to act in a manner that combats climate change. This type of campaigning may be central to the persuasion process. Furthermore talking in generalities to the public, but sticking to the truth is important. Many times campaigns tend to exaggerate the normative nature, and actually cause an opposite reaction than attended. For example, trying to scare people by exaggerating and saying 40% of people who drink drive may actually make the public think that drinking and driving is the normative (Barokas 1995). In the same case, saying almost everyone doesn't do stuff about climate change, which is causing the planet to go through heavy droughts and natural disasters, may actually make people think it is the norm to not worry about climate change. It is important to in the

campaign of spreading knowledge and ensuring that there are norms of actions against climate change that this does not happen (Barokas 1995). Using alarm is also important, but to an extent because the same type of normative issues may arise in when used in a very drastic manner (Barokas 1995). Lastly, these campaigns have to be geared to each group like I've said before.

Catering to opposing groups is not the only thing that's important but ensuring that even supporters sense the urgency in the issue. Much of the supporters believe that climate change is a manmade issue and is relevant in today's world, but they do not have a sense of urgency to act on the problem. A method that would ensure that everyone exhibits a sense of urgency is to remake the framing of the campaigns to also relate to public health issues. As I have explain in chapter 6, much of the activist that campaign for actions against climate change are environmental activist and usually explain climate change as an environmental issue, which is a more alienated form. Instead, what must be done is framing climate change in a more human health perspective because human health seems to directly connect people to the problem of climate change. Most people feel more connected when they understand that a problem may directly affect their health, the health of their close peers, or the health of people in their nation of interest. There is, however, a caveat to this, for the human health problems that resonate from climate change should not rely on and be explained in too much gore or extreme violence because too much fear can lead to the feeling of helplessness both in the target market and unintended market (Henley and Donovan 1999). Arousing too much fear has been shown to be counterproductive when attempted to persuade people to abandon behaviors such as smoking, drug, and alcohol abuse (Firestone 1994). In addition, too much

fear may lead to fatalistic thinking and maladaptive responses like depression (Soames 1988; Rippetoe and Rogers 1987). In fact, helplessness has been showed to be a major cause of depression, and the last thing that a public health campaign should engender is another human health problem like depression (Seligman 1975). All in all, a human health perspective in making a campaign will create the most support and encouragement and will get more people to listen to the information at hand and should be utilized to create a sense of urgency, in regards to the impacts of climate change, among all groups, and would especially help those in groups that support climate change, but feel a lack of necessity to do something about it.

As second tier of the approach, focus on the government involvement of climate change is equally important to spreading public knowledge of the issue. Firstly, spreading the knowledge will already ultimately change policies in countries around the world, for many countries are a democracy and will follow what the public supports. The governments of the world should band together to make a dual dimension approach to climate change: one dimension focusses on adaptations and one dimension focuses on integration. Of course both of these programs shouldn't be done separately, but integrated in with each other. As I have stated before, both programs when complimenting each other will work well and harmoniously, and if they oppose each other, it can be detrimental to the efficacy of the policies. Thus, it is in the best interest to create adaptation and mitigation policies together.

Adaptations are strategies geared to increase the society's resilience to climate change. Of course adaptation strategies that should be implemented must ultimately be shaped to fit the environment and society that the country exists in. For example, levies to

block flooding would be an inefficient adaptation technique implemented by land surrounding countries. The only stipulations to adaptations that fit each country should be that the adaptations should not interfere with mitigation policies as well. Examples of adaptations that should occur include creating and managing buffer zones around reserves and creating reserve networks, initiate strategic zoning of land use to minimize climate change impacts, and economic and science policy analysis that would ensure that a wrong path is not taken (Subrahmanyam 2015 and Team 2015). These are just some of the strategies that won't interfere much with mitigation policies. It is also important to incorporate extensive and continuous research to ensure that these processes aren't interfering with other climate change policies, and what would be the most effective way to rectify the situation if there is interference.

Mitigation refers to efforts to reduce or prevent emission of greenhouse gasses. One, mitigation strategies must be taken within each country to effectively regulate climate change impacts. These strategies should first start out more lenient but (not too quickly but somewhat quickly because the impacts of climate change could be detrimental in the near future) over time change to be stricter. Such strategies for mitigation is starting with small regulations for energy usage per household, and energy usage from other companies, but also have an incentivized program (that could include tax cuts on the individual and company level; i.e. tax cuts for purchasing more electric cars or tax cuts for company's reduction of greenhouse gas production) that would curb greenhouse gas producing activities, or that would foster using greener energy and more efficiency. There also needs to be more government involvement in creation and development of green energy (in fuel and in energy

usages) as well as greenhouse gas sinks. Soon there must be, however, stricter laws against greenhouse gas pollution against big manufacturing companies, and regulations on an individual level in order to curb climate control. Although for smoking cessation, taxing worked well to curb smokers from their habits, taxing may not work so immediately on a society where the prevalence of using energy that emits greenhouse gasses is high. Furthermore, countries should switch their energy supply from higher polluting resources like coal to lower to no polluting resources like natural gas and green energy sources. These are countries that are obviously already developed and could afford research and development.

For developing countries that don't have as much capital to invest in development, developed countries must help these developing countries to be pushed into a more infrastructural-stable society. Coal is one of the biggest sources of greenhouse gasses, and is being used to fuel electric generators around the world since it provides reliable and inexpensive power that the world needs to fuel electric demand and grow economies, which is especially true among developing nations (Institute for Energy Research 2015). Therefore, it is the developed nations' responsibility to help these developing nations to grow more stable to help reduce carbon emissions.

This global strategy can be further helped to ensure success by the implementation of another global strategy that has previously shown much success: the international emissions trading system. This is a system tracks "carbon" via greenhouse gas emissions as currency to gather which country spends the most carbon. There is a limit of spare "carbon" that each country can spend yearly, but once they go over the limit the country must pay costs to buy

more "carbon." Furthermore, if in a year the country does well below their carbon limit they can rollover that "carbon" currency, and lastly, by helping other countries develop, a country may be able to gain extra "carbon" currency (Gottleib 2001). This has shown moderate success in its mediocre implementation since the Kyoto Protocol, and if implemented more strictly and more effectively better results may produce (Skjaerseth and Wettestad 2008). These are some global strategies that must happen to curb this climate change dilemma. Like the public level of climate change campaigning, constant research and assessment of the strategies that are currently being used must continue to prevail, and alterations to strategies must take place to ensure that the efficacy of the campaign is still high.

In conclusion, there is equal importance to cater to public and the governmental policies to ensure that, as a human race, we can combat this climate change. The public arena's support will allow governmental policies to pass, and the success of governmental policies will usher in more support on the public level. Knowledge, mitigation, adaptation, continued research and assessment, and the type of framing must occur on both levels (governmental and public) if a campaign for climate change is to be successful. As a human health issue, in both arenas this dilemma should be portrayed in a public health way because that will bring in the most support as this method of framing connects the most people. Patience and expedition must be implemented because more detrimental impacts of climate change or coming in the foreseeable future, but we must not expect everyone to change immediately. Like many public health issues it takes time in spite of the impending urgency ahead. It seems as if much of the problem of climate change and public inaction when we

individuals will all understand that climate change is for certain the next biggest public health issue and concern and we must combat it in a public health way.

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BIOGRAPHY

Nihanth Palivela was born in Kakinada, Andhra Pradesh, India on September 3, 1995, and moved with his mom and brother to Houston, Texas, United States of America, in 1996, one year after his birth and one year after his dad had moved. After moving constantly throughout Houston, he and his family finally settled in Cypress, a suburb of Houston. He enrolled in the Plan II Honors program at the University of Texas at Austin in 2013 and studies Biochemistry along with Plan II Honors throughout college. In college, he worked in MD Anderson to help write a research paper on the relationship between coupler size and thrombosis, and it became published in 2017. He graduated in May of 2017 with a Bachelor of Arts in Plan II and a Bachelor of Science and Arts in Biochemistry. He plans to go to medical school and get an MD/PhD after taking a gap year to see his family in India and travel around the world. He will apply this cycle and hopefully make it. He will also utilize this gap year by researching in Baylor. He hopes his journey will happen fortunately, and thanks you and feels humbled that you read a portion, if not the entirety, of his thesis. He hopes you have enjoyed it.